



Office of Civilian Radioactive Waste Management

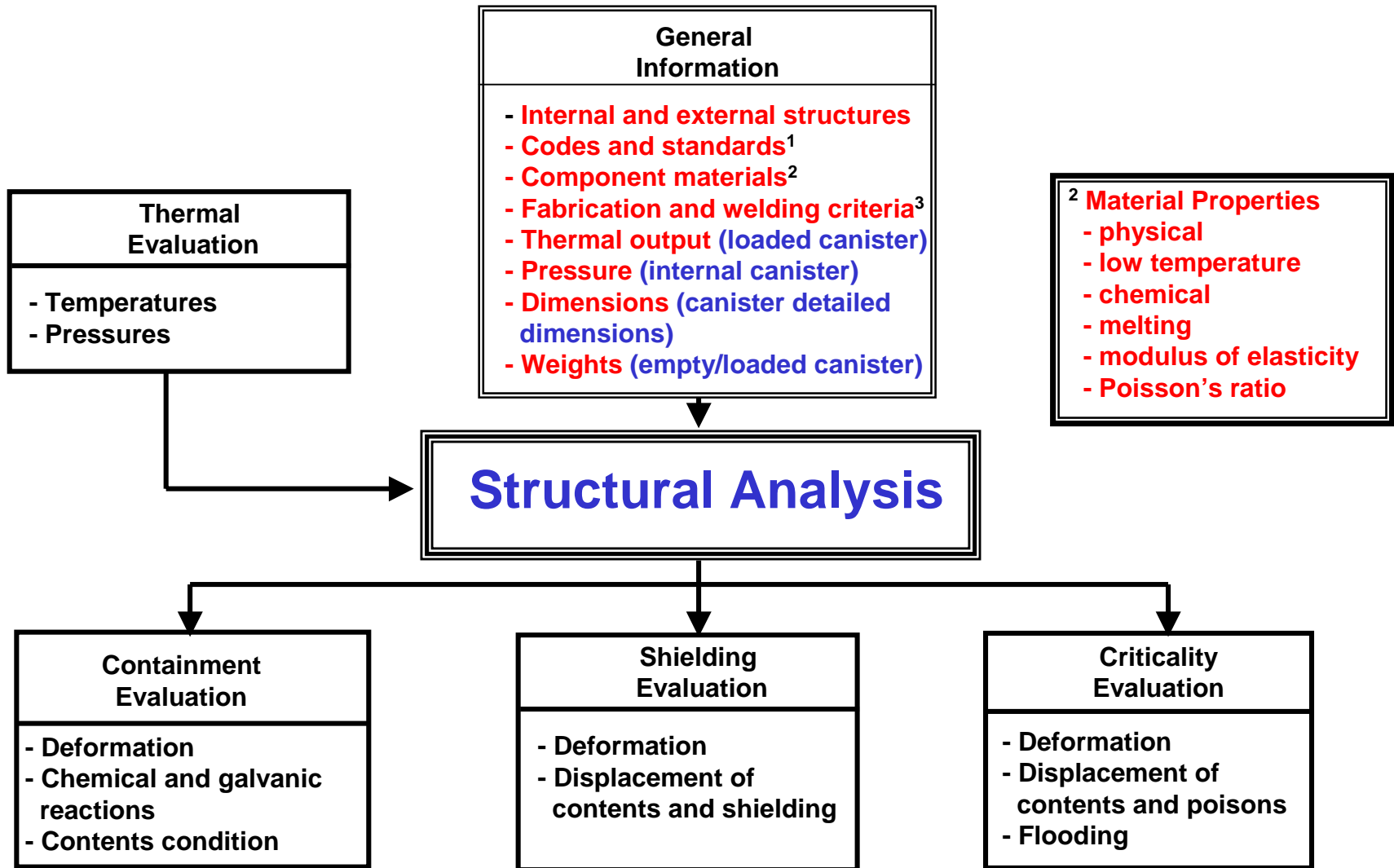
RW/EM TRANSPORTATION MEETING

San Antonio, Texas - January 8-9, 2002

NRC Requirements and Transportability Analysis

William Lake
RW-44

Data Needed to Support SAR*



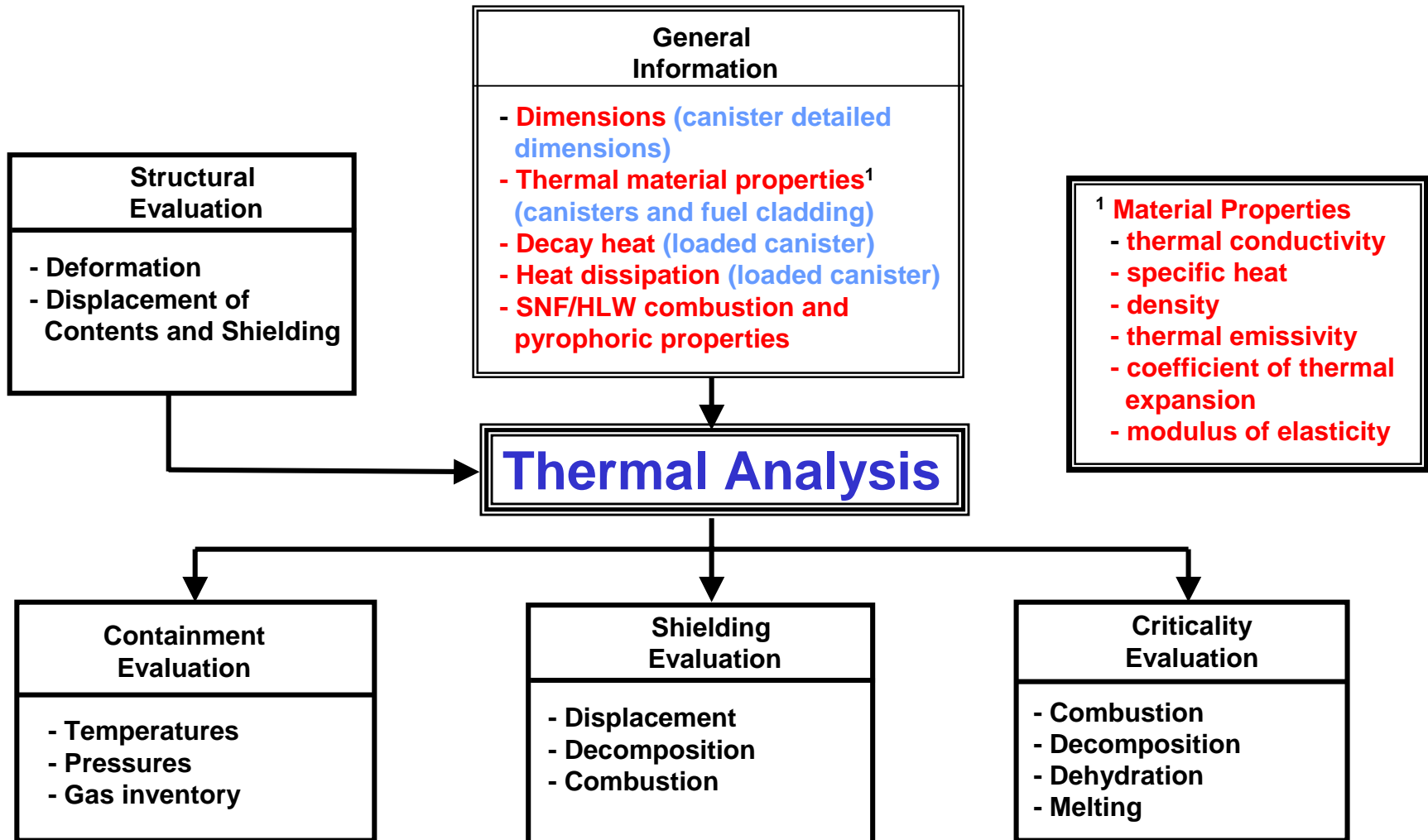
¹ per NUREG/CR-3854

³ B&PV Code Division 3 Code

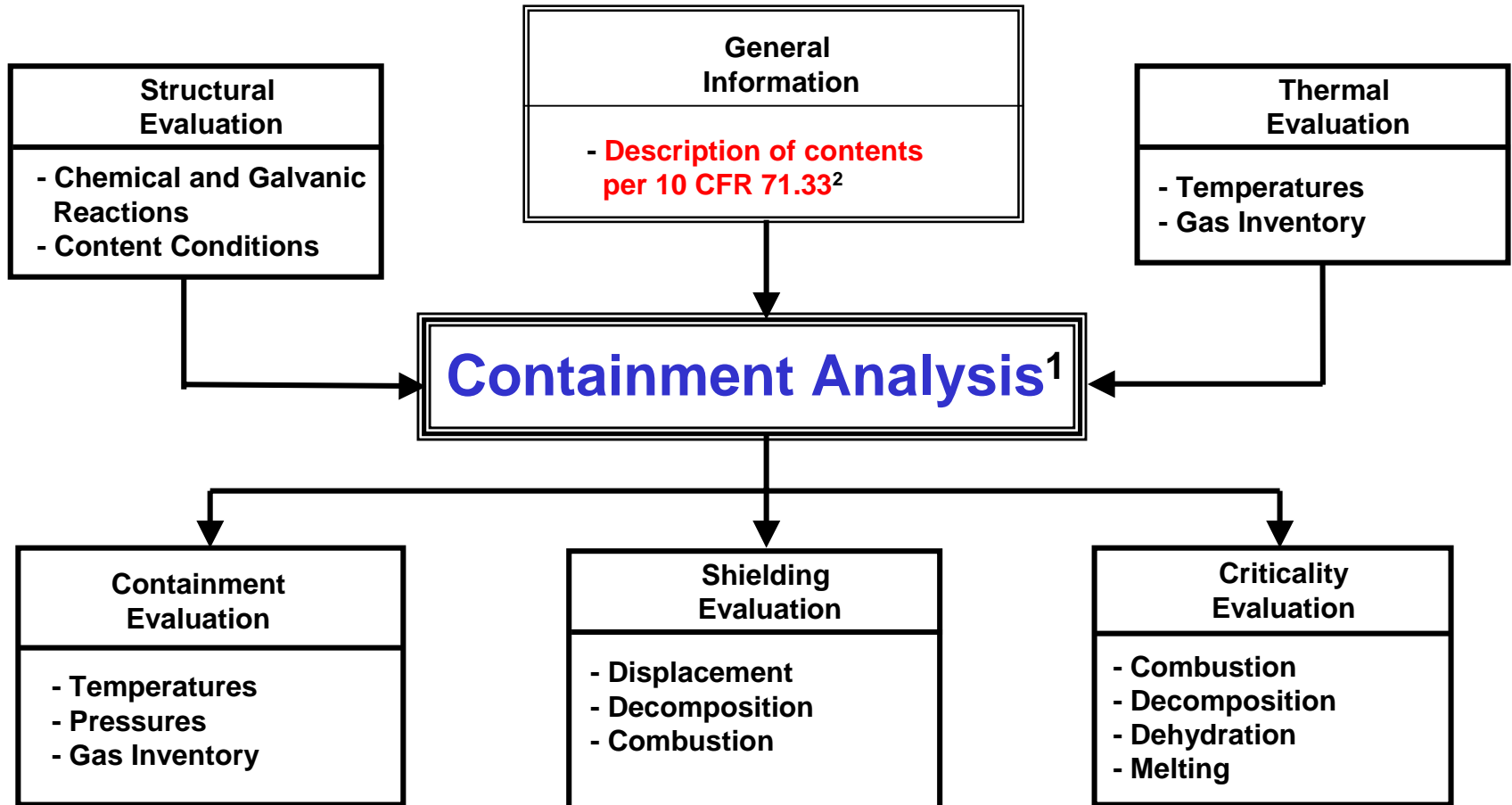
* per NUREG-1617

Red Text indicates where specific inputs are required from EM

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¹ procedures for determining containment criteria are contained in NUREG/CR-6487

² NUREG-1617 paragraph 4.5.1.3 defines special requirements for damaged SNF

Contents Description

10 CFR 71.33 Requires -

(b) with respect to the contents

- (1) Identification of the maximum radioactivity of radioactive constituents,
- (2) Identification and maximum quantities of fissile constituents,
- (3) Chemical and Physical form,
- (4) Extent of reflection, the amount and identity of non-fissile materials used as neutron absorbers or moderators, and the atomic ratio of moderator to fissile constituents,
- (5) Maximum normal operating pressure, (canisters)
- (6) Maximum weight, (empty/loaded canister)
- (7) Maximum amount of decay heat.

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Determinations of Releasable Source Terms

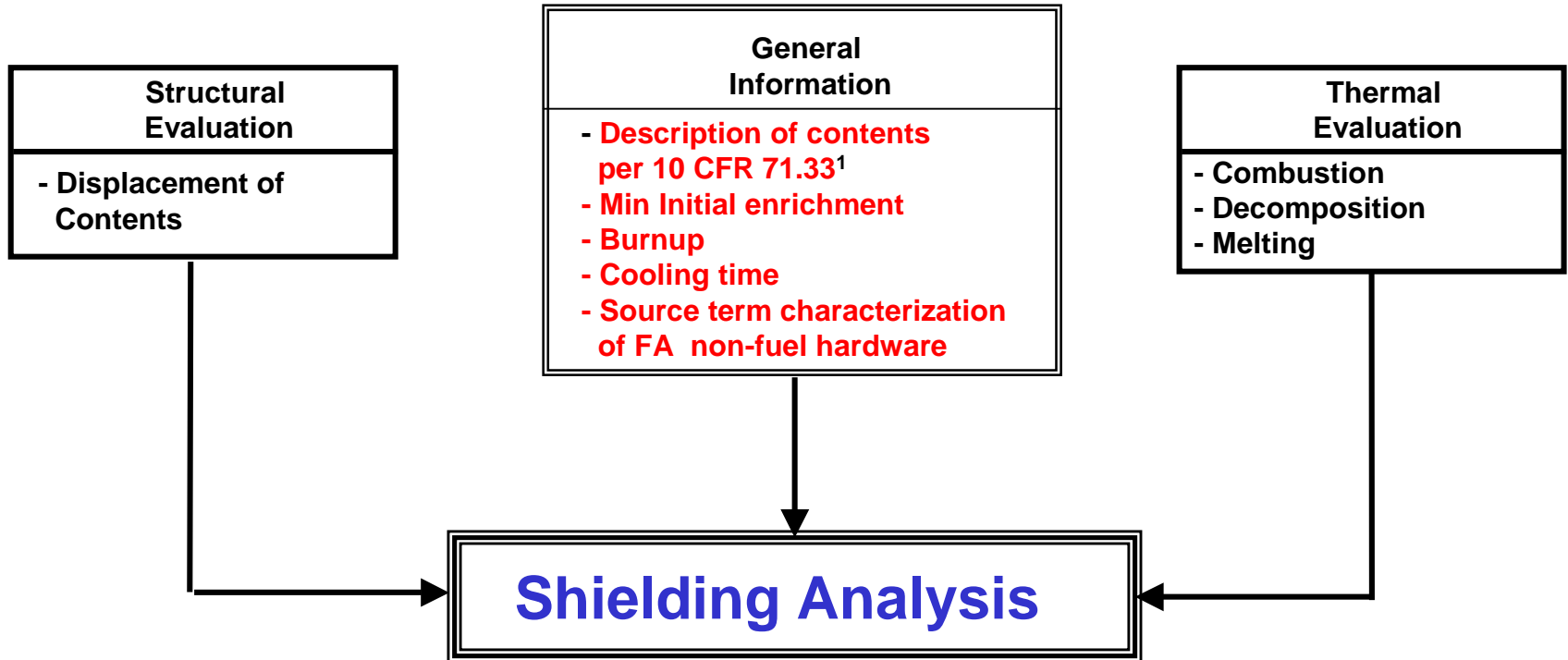
- Release fractions presented in Table 4-1 of NUREG-1617 are considered bounding¹ and were developed from reasoned argument and experimental data. *Cask designers must justify* release fractions and specific activities to suit the contents as appropriate.

Variables considered in the determinations include;

- Fraction of crud that spall-off of rod,
- Crud surface activity [Ci/cm²],
- Mass fraction of fuel that is released as fines due to a cladding breach,
- Specific activity of rods [Ci/g],
- Fraction of rods that develop cladding breaches,
- Fraction of gases that are released due to a cladding breach,
- Specific activity of gases in fuel rod [Ci/g],
- Specific activity of volatiles in a fuel rod [Ci/g],
- Fraction of volatiles that are released due to a cladding breach.

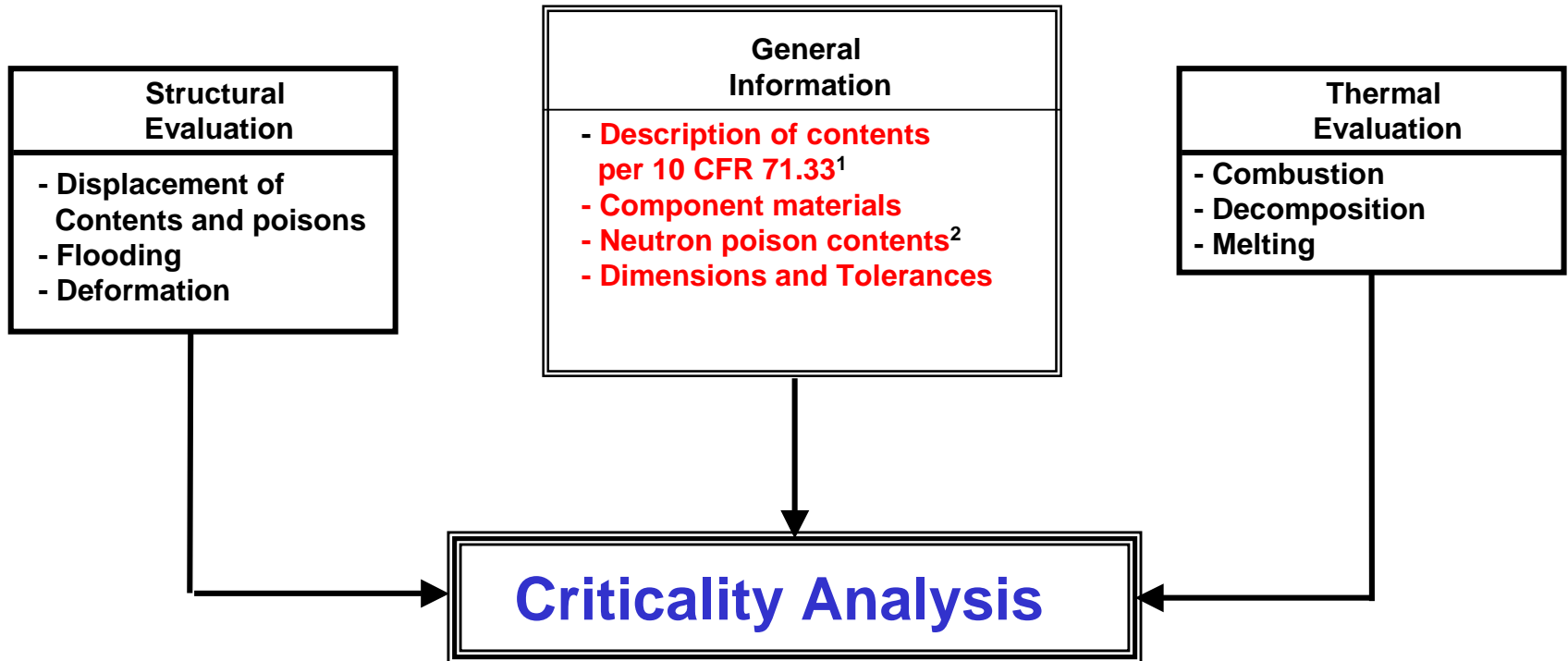
¹ Bounding limits are applicable only to UNDAMAGED SNF. Release fractions for damaged SNF should be justified in the SAR.

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¹ NUREG-1617 paragraph 4.5.1.3 defines special requirements for damaged SNF

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¹ NUREG-1617 paragraph 4.5.1.3 defines special requirements for damaged SNF

² No credit should be taken for burnable poisons

* per NUREG-1617

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Description of Spent Fuel Contents Required for Criticality Analysis¹

- Types of fuel assemblies,
- Detailed dimensions of fuel
 - annular pellets(as applicable),
 - cladding,
 - fuel cladding gap, pitch, and rod length,
- Number of rods per assembly,
- Materials and densities,
- Active fuel length,
- Enrichment(by rod if applicable) BEFORE irradiation,
- Chemical and physical form,
- Mass of initial heavy metal per assembly or rod,
- Number of fuel assemblies or individual rods per canister or package as applicable.

¹ Per NUREG-1617, Paragraph 6.5.2

Criticality Requirements in 10 CFR 71 (paraphrased)

- **10 CFR 71.55(b) except as provided in paragraph (c), a package must remain subcritical if water were to leak into the system or liquid contents were to leak out for the following conditions:**
 - 1. The most reactive credible configuration**
 - 2. Moderation by water to the most reactive credible extent,**
 - 3. Close reflection by water on all sides, or by other surrounding material if worse.**
- **10 CFR 71.55(c) - The Commission may approve exceptions for packages with features that preclude leakage of water for a single error, and if appropriate measures are taken before shipment that the containment system does not leak.**

Discussion of Requirements of 10 CFR 71.55

- The criticality requirements of 10 CFR 71.55 are the so-called “flooded single package requirement”.
- To get an exception from this requirement the design must be water-tight and designed so that no single error could result in leakage into or out of the containment system.
- The exception must be approved by the Commission, (i.e., the Commissioners) not staff. This is a long and difficult process, which is seldom, if ever, successful.
- For calculation of an array of packages, leakage of water into all packages in the array does not seem to be required by the regulations.

Reference Documents

Containment

- **ANSI N 14.5** - “American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials.”
- **NRC Bulletin 96-04** - “Chemical, Galvanic, or Other Reactions in Spent Fuel Storage and Transport Casks.” (OMB No. 3150-0011)
- **NUREG/CR-6487** - “Containment Analysis for Type B Packages Used to Transport Various Contents.”
- **WSRC-TR-98-00317** - “Bases for Containment Analysis for Transportation of Aluminum-Based Spent Nuclear Fuel”
Westinghouse Savannah River Company.

Criticality

- **NUREG-1647** - “Use of Neutron Poisons for Criticality Control in Transportation Packages.”
- **NUREG/CR-5661** - “Recommendations for Preparing the Criticality Safety Evaluation of Transportation Packages.”